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ABSTRACT

The effect of stimulus prefamiliarization on children's discrimination learning was investigated. Kindergartners were prefamiliarized with pictures which were identical, similar, or unrelated to pictures used in the learning task. Consistent with predictions derived from previous research, the learning of subjects who were prefamiliarized with unrelated pictures was superior to that of subjects who were prefamiliarized with identical pictures. In addition, improvement over trials in the similar picture condition resembled that of the unrelated (rather than identical) picture conditions, thereby suggesting that the particular pictorial representations of the experimental materials are at least partially responsible for the effect. (Author/CS)

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Picture-Word Differences in Discrimination Learning: II. A Preliminary Investigation of Picture Prefamiliarization[1]

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The empirical finding that pictures are superior to words in discrimination learning tasks (cf. Rowe, 1972; Rowe & Paivio, 1971; Wilder & Levin, 1973) has recently been examined vis-à-vis the frequency theory of verbal-discrimination learning initially proposed by Ekstrand, Wallace, and Underwood (1966). Chatala, Levin, and Wilder (1973) found that the situational frequencies of experimentally-presented pictures were judged higher and with less variability than were their corresponding verbal labels. Given this result, it follows from the frequency theory that pictures should be more easily discriminated than words since the basis for successful performance on a discrimination task is assumed to reside in frequency discriminations; thus, if the apparent frequencies of pictures are larger and more stable than those of words, frequency discriminations should be easier with pictures.

As a tentative explanation of this effect, Chatala et al. (1973) speculated that the differences in the frequency judgment task, and in discrimination learning tasks, might be due to differences in the pre-experimental or "background" frequencies of pictures and words. In these experiments the pictures typically used as stimuli consist of common objects that are undoubtedly familiar to the subjects, but which are represented by line drawings that the subjects have never actually seen before. Thus, the particular pictures employed possess low (in fact, zero) background frequencies in comparison to their high-frequency verbal labels. The picture-over-word effect can therefore be explained by generalizing Weber's law to frequency judgment and frequency discrimination tasks; that is, adding a frequency "unit" to items

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already high in frequency (words) should be less noticeable than adding a unit to items low in frequency (line drawings).

Taking this argument a step farther, Ghatala and Levin (in press) investigated frequency judgments of words and pictures at three different grade levels (K, 3, 5). They reasoned that the background frequency of words should increase with age and/or increased language experience, whereas the background frequency of previously unseen line drawings should not. Consistent with predictions derived from Weber's law, it was found that differences in frequency judgment performance between pictures and words (in favor of pictures) were greater for older than for younger children.

Despite background frequency differences associated with different kinds of stimulus materials (e.g., pictures vs. words), it should be possible to devise experimental procedures to influence these, with a corresponding effect on subsequent learning. As evidence, previous experiments employing verbal stimuli have produced inferior discrimination learning following prefamiliarization with the stimulus materials (Berkowitz, 1968; Wallace & Nappe, 1970)--a result anticipated by Weber's law. If, according to the Ghatala et al. (1973) hypothesis, pictures possess lower background frequencies than words, then Weber's law would also predict that the negative effects associated with prefamiliarization would be more pronounced for pictures than for words.

As a preliminary step in evaluating this prediction, the present experiment sought to demonstrate that deleterious effects on discrimination learning could indeed be produced through prefamiliarization with pictures. Secondly, in order to determine whether these anticipated effects are attributable to the particular pictorial representations of the materials employed (hypothesized by Ghatala et al., 1973), different variations of picture familiarization were incorporated as described in the following section.

Method

Subjects

The subjects were 45 kindergarten children from a semirural southeastern Wisconsin town. Subjects were randomly assigned (in equal numbers) to the three experimental conditions as they arrived for testing.

Design and Materials

The three experimental conditions utilized different materials during the prefamiliarization phase of the experiment. Subjects in the first condition were given materials identical to those used in the learning task (Same). Subjects in the second condition were given materials that were similar to the test materials (Similar). For example, if a test picture was a house, the Similar prefamiliarization stimulus was a different picture of a house. This condition was included in order to separate out effects due to the unique visual characteristics of the pictures from their "prototypic" aspects (Rosch, 1973) and/or from their implicitly associated verbal labels. Subjects in the third condition were given irrelevant prefamiliarization materials, that is, pictures unrelated to the test stimuli (Irrelevant).

The materials were 54 pen sketches of common objects. Pictures used in the prefamiliarization phase were approximately two to three inches in size on a 5" x 8" white background and mounted in clear plastic. Pictures used in the learning phase were mounted on cardboard pages and placed in booklets. Nine pairs of pictures were presented to subjects for three trials, with the right-left placement of the "correct" stimulus and the serial order of the nine pairs randomized for each trial. The materials used in the learning phase were the same for all subjects.

Procedure

All subjects were prefamiliarized individually on two occasions, the day

before the task and immediately before the task. Prefamiliarization consisted of playing matching games with the 18 pictures to be used in the discrimination task (Same condition) or with 18 different pictures (Similar and Irrelevant conditions), the experimenter and the subject having identical sets of the 18 prefamiliarization pictures. The first session involved two games. In the first game the experimenter randomly chose a picture from his set and placed it in front of the subject who then matched the picture with one from his set placing it beside the picture put before him by the experimenter. This was continued until all 18 pictures were matched. For the second game of the first session one set of pictures was placed before the subject in a three-by-six array. The experimenter again randomly selected a picture from his set and gave it to the subject who in turn placed the picture on its duplicate in the array until all 18 pictures were paired.

The second prefamiliarization session involved a matching game similar to the second one of the first session. The 18 pictures were again placed before the subject in a three-by-six array but this time when the experimenter presented a picture, the subject pointed to its duplicate in the array. In all prefamiliarization activities (which lasted about ten minutes on Day 1 and about five minutes on Day 2) the experimenter refrained from labeling the pictures.

All subjects were administered the learning task on Day 2 immediately following prefamiliarization. A single study trial was followed by two anticipation trials on which subjects indicated their choices by pointing or labeling. A five-second presentation rate was employed, with a ten-second intertrial interval.

Results

Performance was assessed by the number of correct discriminations on the

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two response trials. The mean performance of the three experimental groups is presented in Figure 1. While there were no significant differences among pre-

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Insert Figure 1 about here

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familiarization conditions on the first response trial ($F < 1$), the results of the second response trial supported the major hypothesis in that subjects in the Irrelevant condition produced significantly more correct discriminations than did subjects in the Same condition according to Tukey's multiple comparison procedure with $\alpha=.05$.

The performance of subjects in the Similar condition was intermediate to (though not statistically different from) that of subjects in the two other conditions. However, Similar subjects' pattern of learning from the first to the second response trial resembled that of Irrelevant rather than Same subjects, in that subjects in both the Irrelevant and Similar conditions experienced significant improvements, $t(14)=2.63$, $p<.01$ and $t(14)=2.67$, $p<.01$ respectively, while subjects in the Same condition actually experienced a slight (nonsignificant) decrease, $t=-.14$.

Discussion

As has been argued previously, the applicability of Weber's law to tasks such as this may be demonstrated by both experimental and extra-experimental manipulations (Ghatala & Levin, in press). In the present experimental application it was found that prefamiliarization with previously unseen pictures served to depress subsequent discrimination learning performance. Based on earlier investigations in which prefamiliarization with verbal materials also resulted in inferior discrimination learning (Berkowitz, 1968; Wallace & Nappe, 1970), the present result was not unexpected. However, in order to

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substantiate the claim that picture-word differences in discrimination learning are attributable to the differing background frequencies of the two types of material (Ghatala & Levin, in press; Ghatala et al., 1973), further experimentation must be conducted.

In particular, a direct comparison of picture and word prefamiliarization effects must be made. Given our "differing background frequencies" explanation we would have to predict that picture prefamiliarization would produce more adverse effects on subsequent discrimination learning than would word prefamiliarization. In fact, precisely the same result would be anticipated when comparing prefamiliarization effects with low- and high-frequency words, the low-frequency words being somewhat analogous to pictures in terms of background frequency. Although there are currently-available data bearing on this latter prediction (Lovelace & Pulley, 1972), unfortunately they are uninformative due to an inadvertent confounding of stimulus frequency and meaningfulness (cf. Allen & Garton, 1968). At the same time we would anticipate smaller negative prefamiliarization effects if frequently encountered (pre-experimentally) pictures, photographs, or objects comprised the experimental materials, instead of previously unseen line drawings.

The data from the Similar condition support the notion that the prefamiliarization effect is associated to some extent with the particular pictorial representations rather than their more general (e.g., prototypic) characteristics or their verbal labels.[2] Obviously if the effect had more to do with the general than with the particular aspects of the pictures, no difference between subjects in the Same and Similar conditions would have been detected. To the contrary, in this experiment the performance of subjects in the Similar condition was quite unlike that of subjects in the Same condition, and quite like that of subjects in the Irrelevant condition (where the

prefamiliarization pictures were perceptually and conceptually dissimilar from the discrimination learning pictures). However, since the overall performance of Similar subjects was somewhere between that of subjects in the two other conditions, it would be injudicious to conclude that general (prototypic) visual aspects of the pictures and/or their associated verbal labels were not involved to some degree. Teasing these factors apart systematically would seem to be a worthwhile (and experimentally plausible) contribution.

In continuing to pursue this line of research (see also Levin, Ghatala, & Wilder, in press) we hope to understand the mechanisms underlying the "picture-over-word" phenomenon not only in discrimination learning, but in other types of learning as well. Moreover, eventually we hope to expand the current postulates of frequency theory (Ekstrand et al., 1966) in order to account for performance differences heretofore ascribed to age differences, modality effects, instructional strategies, and other memory attributes which we have been wont to deal with independently.

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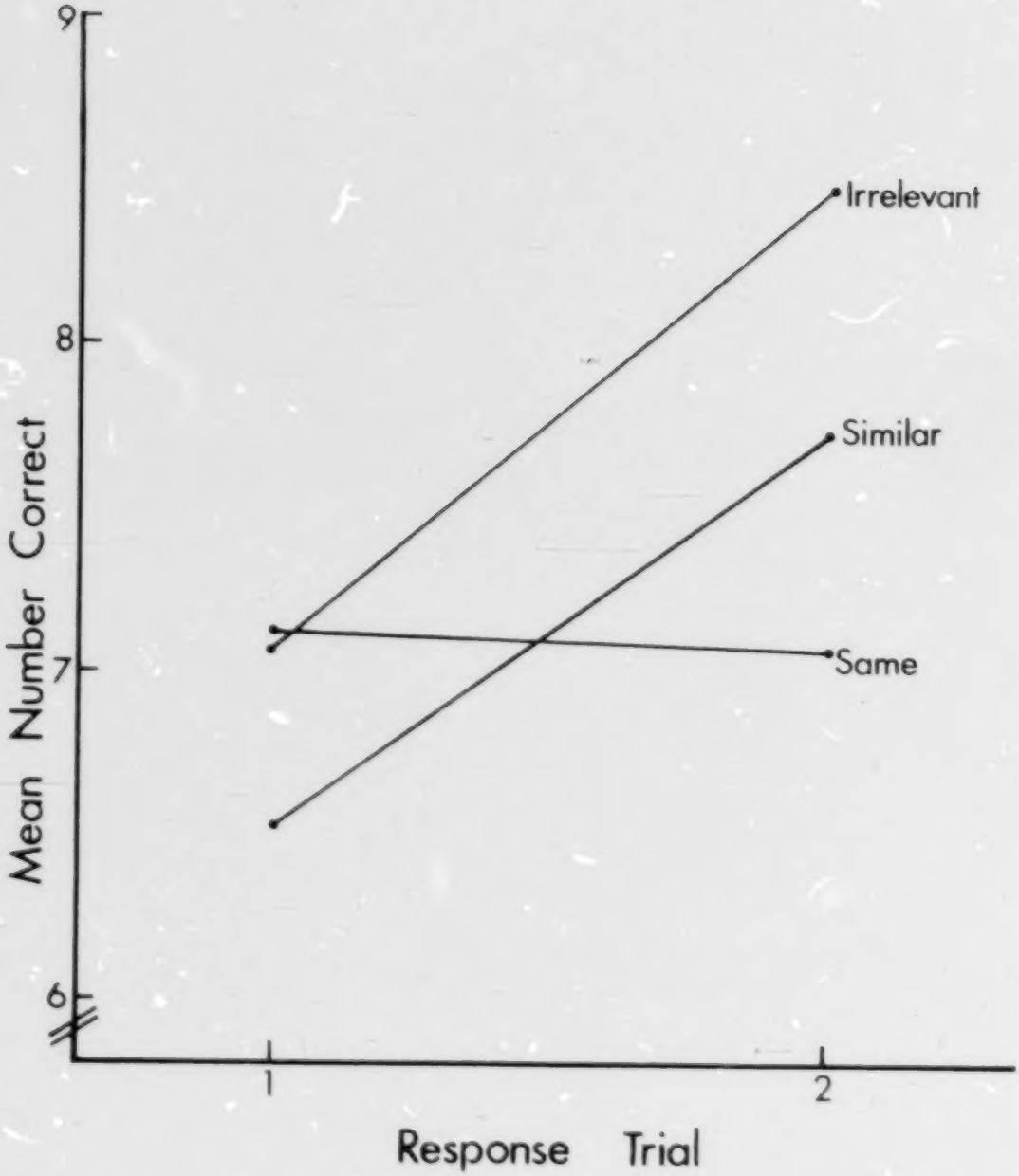
Figure Caption

Figure 1. Mean Discrimination Learning Performance of Subjects in the Three Experimental Conditions on the Two Response Trials.


9
8
7
6
Mean Number Correct
Irrelevant
Similar
Same
1
2
Response Trial

Footnotes

[1] This research was done at the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions herein do not necessarily reflect the position or policy of the Office of Education and no official endorsement by the Office of Education should be inferred. Center No. C-03/Contract OE 5-10-154. The experiment was conducted as part of the first author's Master's thesis. We are grateful to Professors Larry Wilder and Robert E. Davidson for their assistance in planning the study, to the staff and students of Oregon Elementary School in Oregon, Wisconsin for their cooperation during data collection, and to Cathy Bussey for typing the paper.

[2] Some recently collected data serve as an indirect corroboration of this notion, in that we have found that performance on a frequency judgment task (cf. the introduction of this paper) is substantially hampered when different pictorial representations of the same general object class are presented on study and test trials (e.g., a picture of an alley cat and a picture of a Siamese cat).